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Neutron Stars as the Generators of Baryonic Dark Matter Particles

The discrepancy between the average measured lifetime of trapped ultracold neutrons τtrap = (877.75 ± 0.28stat + 0.22/-0.16syst) s and the average beam measured lifetime of neutrons (τbeam = 888.0 ± 2.0 s) is well beyond the error margins. In the trap experiments, the neutron lifetime was determined by directly counting the surviving neutrons. In the beam experiments, the neutron lifetime was determined by counting the protons resulting from the three-body decay of neutrons into free protons and electrons, plus antineutrino, but the two-body decay of neutrons, which does not produce free protons, was missed. If the Branching Ratio (BR) for the two-body decay (compared to the three-body decay) would be about 1%, this would explain the puzzle. However, until recently it was considered that this theoretical BR is by several orders of magnitude smaller than 1%. In our recent paper we showed that the previously known theoretical BR was significantly underestimated and that the actual theoretical BR is about 1%. Thus, the puzzle of the neutron lifetime has been solved completely. In that paper it was also demonstrated that the enhanced two-body decay of neutrons has profound cosmological implications. Namely, it is the mechanism by which neutron stars are slowly but continuously producing baryonic dark matter particles. It was also shown that there is astrophysical evidence of this process.

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